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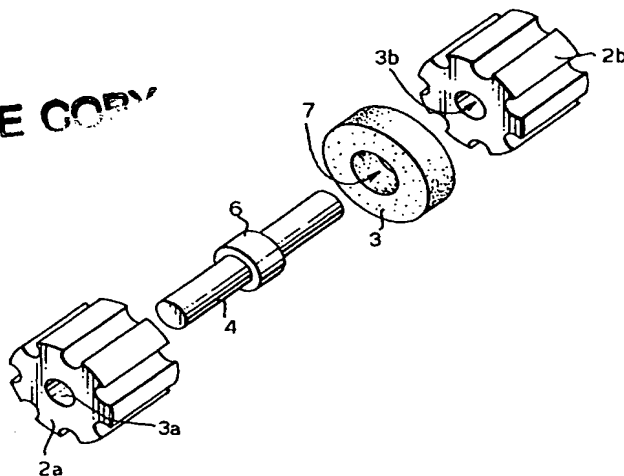
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**Published**  
*With international search report.*

(54) Title: **A SEAL**

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(57) Abstract

A seal (1) for sealing an aperture in an object through which aperture one or more elongate articles extends, which seal comprises: a first support member (2a) having at least one longitudinally extending channel (8a) adapted to accommodate and support an elongate article; a second support member (2b) in use longitudinally spaced from the first support member, the second support member (2b) having at least one longitudinally extending channel (8b) corresponding to that of the first support member (2a); and a sealing member (3) situated between the first and second support members, the arrangement being such that to accommodate an elongate article within the longitudinal extending channel of the first support member so as to extend through the corresponding channel on the second support member it is necessary for the sealing member to be deformed.

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## A SEAL

The present invention relates generally to a seal, and more specifically to a seal for sealing an aperture in an object through which one or more elongate article extends and to objects including such a seal.

The present invention finds particular utility as a seal for protecting junctions between elongate articles such as pipes, tubes or cables. The term "cable" will be understood hereinafter to include both conductive cables and bundles of optical fibres. When it is necessary to make connections between elongate articles such as pipes, tubes or cables the junction or splice where such article are joined end-to-end is necessarily less strong and less resistive to environmental agents liable to cause deterioration over time than the article itself.

In the production of, for example, cable systems such as telecommunication or power transmission systems, it is frequently necessary to make splices either to join cables end-to-end or to make a branch. The cables and the splices may be located underground, in conduits or in other environments, inside or outside buildings, but in any event are always at risk to the ingress of environmental agents such as moisture or dust. Underground installations are also subject to pressure, and in particular hydrostatic pressure, whilst above-ground installations suffer from diurnal thermal variations. In order to provide environmental protection for splices in cables or other elongate articles various protective measures are known. Systems utilising an enclosing casing have been found to be particularly valuable. Such casings or enclosed containers have a housing for enclosing the

cable connections or splices and at least one aperture in the housing wall through which the cable or cables can extend. To ensure adequate protection a seal should be provided for any such aperture.

There is a need for a seal for sealing an aperture in an object which has a simple construction, is easy to install and provides a good sealing performance.

According to a first aspect of the present invention there is provided a seal for sealing an aperture in an object through which aperture one or more elongate articles extends, which seal comprises:

- a first support member having at least one longitudinally extending channel adapted to accommodate and support an elongate article;

- a second support member in use longitudinally displaced from the first support member, the second support member having at least one longitudinally extending channel corresponding to that of the first support member; and

- a sealing member situated between the first and second support members, the arrangement being such that to accommodate an elongate article within the longitudinal extending channel of the first support member so as to extend through the corresponding channel on the second support member it is necessary for the sealing member to be deformed from its rest configuration.

The present invention not only provides a good seal but also performs the function of gripping the elongate article with respect to the aperture. The deformation of the sealing

member by the elongate articles causes the sealing member to seal between and around those articles.

The first and second support members are preferably substantially identical to one another. They may be an integral component, in which case they are joined together by a connecting member. Alternatively the first and second support members may be separate components, which may be optionally joined together by a connecting member which may be integral with one of them.

Each or both of the support members preferably takes the form of a substantially cylindrical body having the said at least one longitudinally extending channel in its periphery. It is preferred that each support member be provided with a plurality of longitudinally extending channels. The channels are open to and extend from the outer periphery of the support member and may take any desired shape or form so as to accommodate the elongate article with which the seal is to be used. They may, for example, be substantially U or V shaped channels. For the accommodation of any connecting member the or each support member may be provided with a longitudinally extending wall, preferably central of the support member and parallel to its longitudinal axis.

The or each support member may be formed from any suitable material and may be elastomeric or rigid in nature. The or each support member may, for example, be formed of a metal, such as aluminium or steel, a naturally occurring elastomeric material such as rubber, or a plastics material, e.g. a polyamide, polycarbonate or polyolefin such as polyethylene or polypropylene.

The sealing member preferably takes the form of a substantially cylindrical block of sealant material. The dimensions of the sealant material block, in particular its cross sectional width, should be at least as great as the corresponding dimension of the first and second support member. The outer dimensions of the sealant material block should, in particular, be greater than the inner dimensions of the longitudinally extending channels so that an elongate article lying in those channels needs to deform the sealant material in order for the elongate article not to be laterally deflected but to lie in a straight line.

The sealing member may generally comprise any suitable sealant. A particular preferred sealant material is a gel sealant. The gel sealant may be any suitable gel or geloid sealant such as silicon, urea or urethane gel. It may take the form of a liquid, extended polymer composition gel sealant, with the polymer comprising an elastomer, or a block copolymer have relatively hard blocks and relatively elastomeric blocks. Examples of such copolymers include styrene-diene block copolymers or styrene-ethylene-propylene-styrene block copolymers. The extender liquids employed in the gel preferably comprise oils, such as naturally occurring hydrocarbon oils, synthetic oils or mixtures thereof. Preferred oils are mixtures of non-aromatic paraffins and naphthenic hydrocarbon oils. Such gels are well known in the prior art.

Any connector member when present may take any suitable form. It may, for example, take the form of a rod formed from any of the materials described above in relation to the first and second support members.

To assist in the support of the elongate articles within the longitudinally extending channels of the first and second support members, additional retaining means may be provided. Such means may take the form of tie wraps and/or tapes or strips. Cable gripping strips could, for example, be wound around the elongate articles either individually or in groups. Such a gripping strip, called an axial pull strip, is disclosed in WO96/09670, which document is incorporated herein by reference. Such strips increase the ability of elongate articles, such as cables, to withstand axial forces and where necessary increase the dimensions of the elongate articles to match the sizes of apertures in the casing.

Additional sealant material may be placed around the elongate articles and the central sealant material if required. Such further sealant material could be used in the form of a tape.

The seal of the present invention has a wide application for the sealing of objects having an aperture. It may, for example, be used as a duct seal, a grommet or "feed through" in a wall, or the bulkhead of a car or other vehicle. More preferably it may be used for the sealing of an aperture in a closed container for containing optical fibre or electrical splices or connections. Such a container may be supplied with seals according to the first aspect of the present invention pre-installed or the seals may be applied separately and installed when used. The seal is particularly suitable for sealing around several small diameter cables in a cable aperture of a cable splice closure.

According to a second aspect of the present invention there is provided a closed container for containing one or more cable splices or connections including a seal according to the first aspect of the present invention.

The container of the second invention may be a cable splice closure such as that described in WO97/45904 which document is incorporated herein by reference. Such a container or cable splice closure contains a housing having at least two parts or half-shells which may be joined together or formed as separate components which are brought together to provide an enclosed container. In addition to the seal of the present invention a sealing material which seals the gap between the cable and housing as it passes through the enclosed container may also be provided. Such sealing material is preferably such that it comes under pressure in use, e.g. by closing the separate parts of the housing or by other means, e.g. by the provision of movable parts of the container. The container, and in particular its housing, may be formed from any suitable material such as those described above for the first and second support member.

The terms longitudinal and lateral refer in general to a direction substantially parallel and substantially perpendicular respectively to the direction in which the elongate article extends.

The present invention is advantageous over known sealing devices and is simpler to use, easier to manufacture and install and yet provides excellent mechanical and environmental protection at the same time as providing effective protection against forces, in particular axial (longitudinal) forces. The strain relief provided with the present invention is easier to achieve than prior art conventional methods requiring the individual wrapping of cables with



tape, which is more time consuming as the number of individual cables increases. The present invention also ensures that the cables remain separate, i.e. spaced from, each other to allow the sealing pressure of the sealant material to be well transferred between the cables.

For a better understanding of the present invention and to show how the same may be put into effect reference will now be made, for the purposes of illustration only, to the accompanying drawings in which:

Figure 1 is an exploded perspective view of a first embodiment of a seal according to the present invention;

Figure 1a and Figure 1b show perspective views of the embodiment of Figure 1 with some of the components assembled;

Figures 2a to 2d is a series of perspective views showing several stages in the assembly of the embodiment shown in Figure 1 in use;

Figure 3 is a perspective view of a second embodiment of the present invention; and

Figure 4 shows a container according to the second aspect of the present invention for use with the seal shown in Figures 1 and 2 or 3.

The seal 1 shown in Figure 1 comprises two support members 2a, 2b formed from an elastomeric material such as rubber or a rigid material such as polypropylene. The two support members 2a, 2b, are laterally displaced from each other and sandwiched between them is a block of sealant material 3. Interconnecting the two support members 2a, 2b is an interconnecting rod 4 of polypropylene. The interconnecting rod is a circular cylindrical rod which passes through circular cylindrical bore holes 3a, 3b provided in the support members 2a, 2b the interconnecting rod 4 is provided with a portion of increased diameter 6 which

supports the sealant material block 3 by engaging in an axial bore hole 7 as shown in Figure 1a.

Each of the support members 2a, 2b is provided with a plurality of longitudinally extending channels 8a, 8b radially arranged around their cylindrical periphery.

As shown in Figure 2a, elongate articles such as fibre optic cables 9 can be accommodated within the longitudinally extending channels 8a, 8b so as to lie substantially parallel to one another. The dimensions of the sealant material block 3 is such that in order to accommodate the cables 9 within the corresponding channels 8a, 8b the sealant material must be squashed by the cables and in doing so is pushed out around at least part of the cables so as to seal between them.

As additional securing means tie wraps 10 may be wrapped around the cables positioned on the seal 1 as shown in Figure 2b. to provide added strength against axial forces an axial pull strip 11 may also be wrapped around the bundles of cables positioned on the seal as shown in figure 2c. In order for large diameter apertures or ports to be accommodated additional sealing material such as a gel tape 12 may be wrapped around the deformed sealant material block 3.

In the second embodiment shown in Figure 3, rather than the first and second support members being separate components interconnected by a separate interconnecting rod, the first 13 and second 14 support members are formed as an integral component with an

integral interconnecting rod 15 extending therebetween. Such an integral component is advantageously formed from a rigid material such as polypropylene.

The seal of the present invention, including the first and second embodiments described above are of use as a cable seal for sealing around several small diameter cables in a cable aperture of a cable splice closure. Such a cable splice closure 16 is shown in Figure 4. The closure 16 is formed from two separate housing parts 17a, 17b which fit together to form an enclosed container. The end 18 of the closure has cable apertures 19, which are formed by the fitting together of the two housings parts 17a, 17b which are provided with U shaped cut outs in the end wall 18. A longitudinally spaced wall 20 defines with the end wall 18 a cavity 21. The seal will fit in to one of the cable apertures 19 such that the central sealant material block 3 is accommodated within the cavity 15 and the support members 2a, 2b or 13, 14, and axial pull strip 11 where present, interlock with the profiled internal surfaces of the walls 20.

## CLAIMS

1. A seal for sealing an aperture in an object through which aperture one or more elongate articles extends, which seal comprises:
  - a first support member having at least one longitudinally extending channel adapted to accommodate and support an elongate article;
  - a second support member in use longitudinally spaced from the first support member, the second support member having at least one longitudinally extending channel corresponding to that of the first support member; and
  - a sealing member situated between the first and second support members, the arrangement being such that to accommodate an elongate article within the longitudinal extending channel of the first support member so as to extend through the corresponding channel on the second support member it is necessary for the sealing member to be deformed.
2. A closed container for containing one or more cable splices or connections including a seal according to Claim 1.
3. A seal substantially as hereinbefore described with reference to and as illustrated in Figure 1 and 2, or Figure 3 of the accompanying drawings.
4. A closed container substantially as hereinbefore described with reference to and as illustrated in Figure 4 of the accompanying drawings.

\* \* \* \* \*

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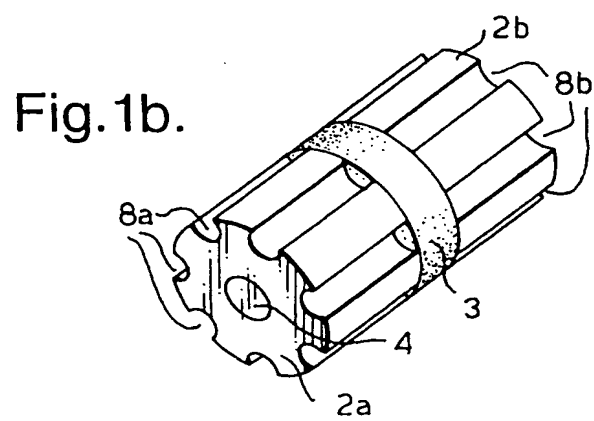
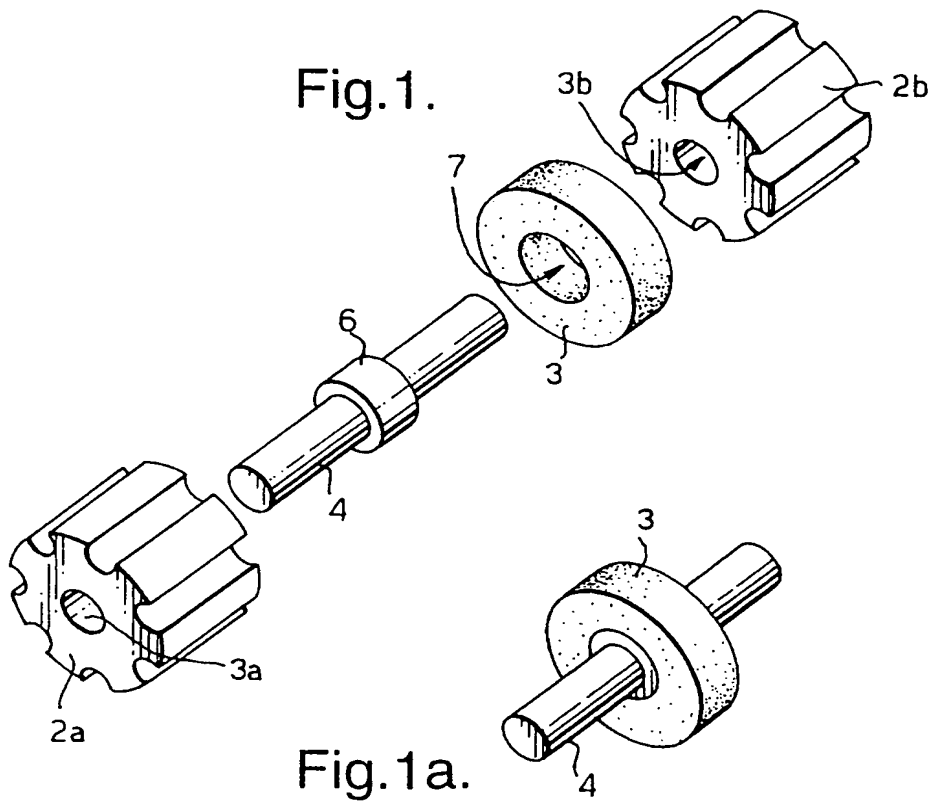


Fig.2a.

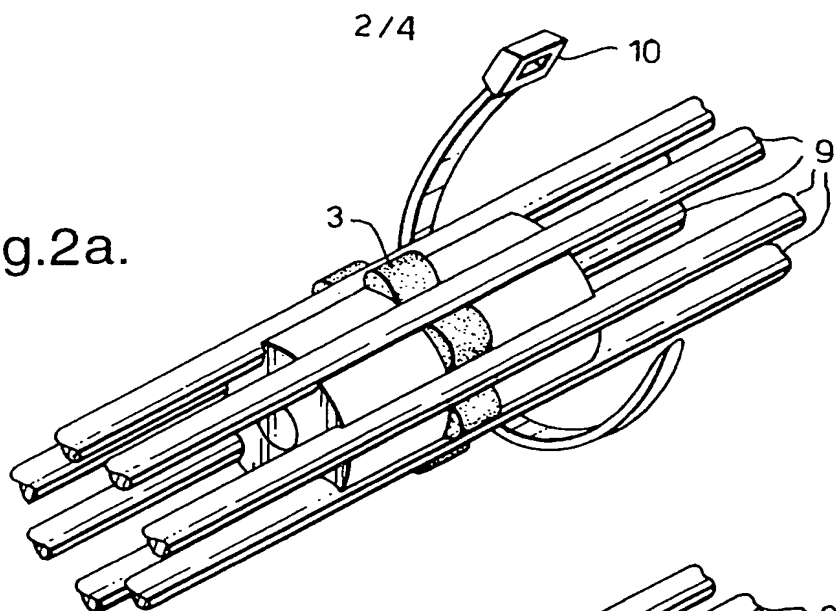


Fig.2b.

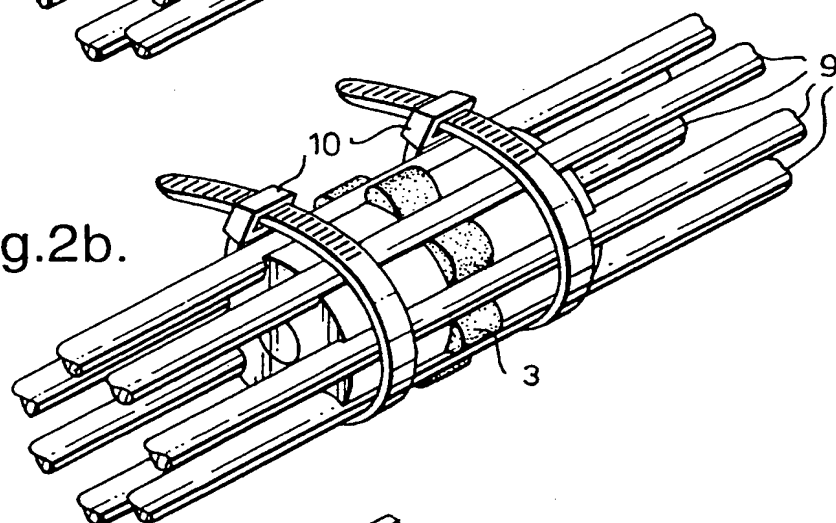
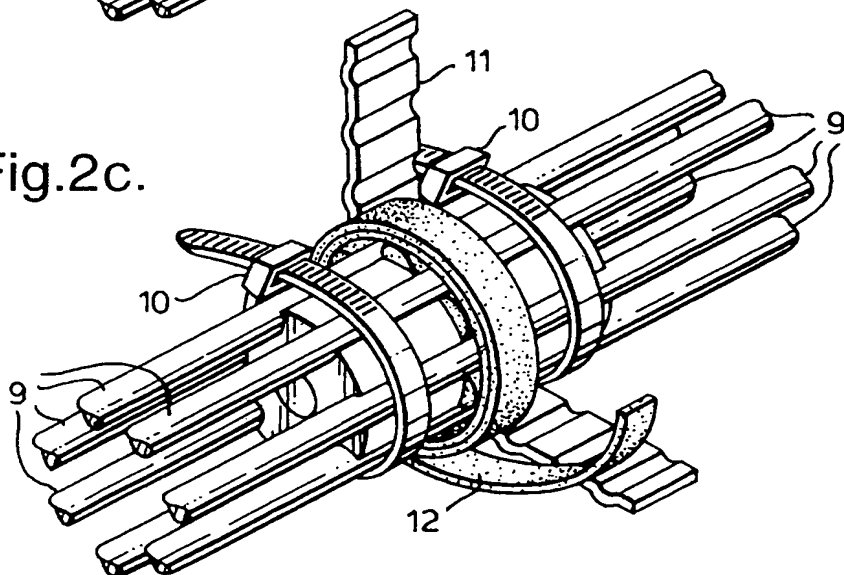


Fig.2c.



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Fig.2d.

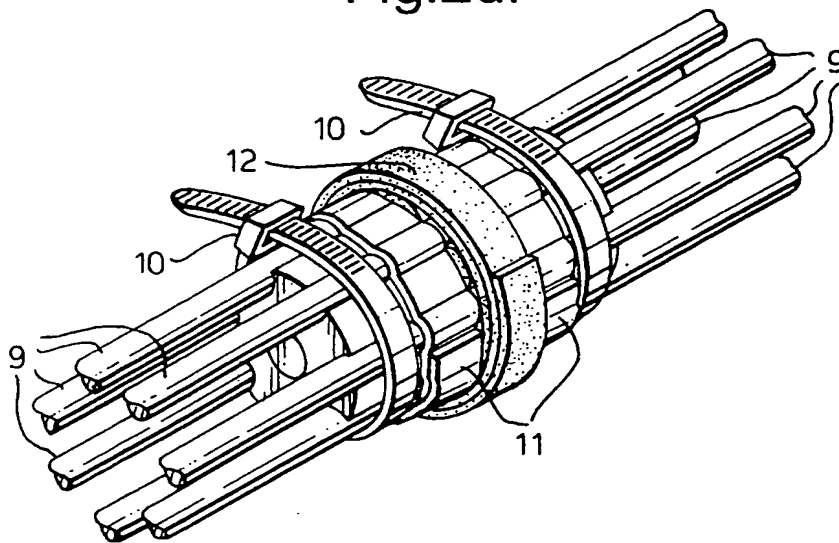
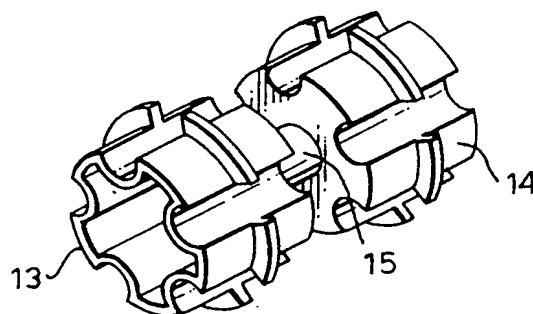
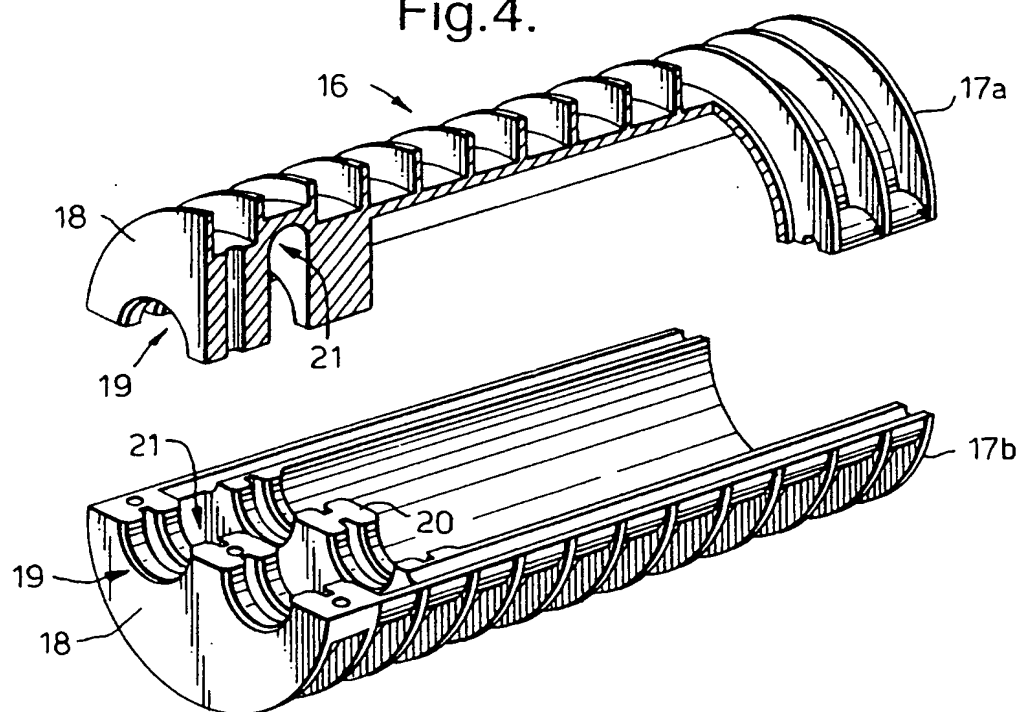


Fig.3.



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Fig.4.





# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 99/01898

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H02G15/013 F16L5/02 G02B6/44

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H02G F16L G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 42693 A (RAYCHEM SA NV ; RAYCHEM LTD (GB); WAMBEKE ALAIN (BE); VANONCKELEN M) 13 November 1997 (1997-11-13) the whole document	1,2
X	US 4 267 401 A (WILKINSON WILLIAM L) 12 May 1981 (1981-05-12) column 5, line 29 - column 6, line 29; figure 3	1,2
A	EP 0 538 008 A (THOMAS & BETTS CORP) 21 April 1993 (1993-04-21) column 11, line 53 - column 12, line 18; figures 1,9,21,22	1,2

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

21 September 1999

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# INTERNATIONAL SEARCH REPORT

International application No.  
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## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☒ Claims Nos.: 3, 4  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:  
see FURTHER INFORMATION sheet PCT/ISA/210
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

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Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: 3,4

Claims 3 and 4 are formulated in a vague and unclear manner

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 99/01898

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